



Patent  
Attorney's Docket No. 040010-440



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT  
APPLICATION TRANSMITTAL LETTER

**Box PATENT APPLICATION**

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Enclosed for filing is the utility patent application of Lila MADOUR and Shabnam SULTANA for WIDE AREA NETWORK MOBILITY FOR IP BASED NETWORKS.

Also enclosed are:

- 13 sheet(s) of [ ] formal  informal drawing(s);
- [ ] a claim for foreign priority under 35 U.S.C. §§ 119 and/or 365 is [ ] hereby made to \_\_\_\_\_ filed in \_\_\_\_\_ on \_\_\_\_\_;  
[ ] in the declaration;
- [ ] a certified copy of the priority document;
- [ ] a Constructive Petition for Extensions of Time;
- [ ] \_\_\_\_\_ statement(s) claiming small entity status;
- [ ] an Assignment document;
- [ ] an Information Disclosure Statement; and
- Other: Unexecuted Declaration

The declaration of the inventor(s) [ ] also is enclosed  will follow.

- [ ] Please amend the specification by inserting before the first line the sentence --This application claims priority under 35 U.S.C. §§119 and/or 365 to \_\_\_\_\_ filed in \_\_\_\_\_ on \_\_\_\_\_; the entire content of which is hereby incorporated by reference.--

## Utility Patent Application Transmittal Letter

Attorney's Docket No. 040010-440

Page 2

The filing fee has been calculated as follows [ ] and in accordance with the enclosed preliminary amendment:

CLAIMS					
	NO. OF CLAIMS		EXTRA CLAIMS	RATE	FEE
Basic Application Fee					\$760.00
Total Claims	7	MINUS 20 =	0	x \$18.00	
Independent Claims	4	MINUS 3 =	1	x \$78.00	78.00
If multiple dependent claims are presented, add \$260.00					
Total Application Fee					\$838.00
If verified Statement claiming small entity status is enclosed, subtract 50% of Total Application Fee					
Add Assignment Recording Fee of \$40.00 if Assignment document is enclosed					
<b>TOTAL APPLICATION FEE DUE</b>					<b>\$838.00</b>

A check in the amount of \$ 838.00 is enclosed for the fee due.

Charge \$ \_\_\_\_\_ to Deposit Account No. 02-4800 for the fee due.

Please address all correspondence concerning the present application to:

Ronald L. Grudziecki  
 Burns, Doane, Swecker & Mathis, L.L.P.  
 P.O. Box 1404  
 Alexandria, Virginia 22313-1404.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in triplicate.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: October 12, 1999

By: Tony M. Cole  
 Tony M. Cole  
 Registration No. 43,417

P.O. Box 1404  
 Alexandria, Virginia 22313-1404  
 (703) 836-6620

**APPLICATION FOR UNITED STATES LETTERS PATENT  
FOR  
WIDE AREA NETWORK MOBILITY FOR IP BASED NETWORKS**

by  
**LILA MADOUR**  
and  
**SHABNAM SULTANA**

**BURNS, DOANE, SWECKER & MATHIS, L.L.P.  
POST OFFICE BOX 1404  
ALEXANDRIA, VIRGINIA 22313-1404  
(703) 836-6620  
Attorney's Docket No. 040010-440**

**Wide Area Network Mobility for IP Based Networks**

**BACKGROUND**

Applicants' invention relates generally to IP based networks and, more  
5 particularly, to mobility between IP based networks.

Fixed data networks, such as the Internet, have conventionally been used for the communication of digital data between different nodes in the network. With the increasing use of mobile nodes, however, such as portable notebook computers, fixed data networks have often become disadvantageous due to the lack of connections to the fixed  
10 data network at any specific location to which a mobile node might roam. To solve this problem, data communications using mobile communications system have been implemented to provide mobility for mobile nodes. Such mobile data communications systems typically involve packet radio systems such as General Packet Radio Services (GPRS) or Cellular Digital Packet Data (CDPD) that use IP based protocols. These  
15 packet radio systems advantageously permit a mobile node to roam within a cellular network while retaining the ability to initiate data communications at any location within the network.

Mobility in data communications is, however, problematic when a mobile node moves across cellular networks. Thus, if a mobile node moves from a first network to a  
20 second network data communications may be lost. For example, in a GPRS system, inter-GGSN (Gateway GPRS Serving Node) communication is currently not defined and, thus, data packets will be lost because a tunnel cannot be established to reroute data packets to the new Serving GPRS Serving Node (SGSN) in the second network from the old SGSN/GGSN in the first network. Seamless data communication with a mobile node,  
25 when the mobile node roams between two heterogeneous packet data networks, thus cannot be achieved using current IP based protocols.

## SUMMARY

It is thus an object of the invention to achieve seamless data communication between two IP based packet networks when a user travels from an area serviced by a first data packet network to an area serviced by a second data packet network.

5        In accordance with a first exemplary embodiment, a method of keeping a session active and connected while changing data communications networks is provided. The method of this exemplary embodiment comprises the steps of: receiving packets, associated with a session, over a first connection in a first data communications network; requesting a second connection with a second data communications network while  
10 moving towards the second network; acquiring an address of a gateway associated with the second data communications network, wherein said steps of requesting and/or acquiring use an unsolicited connection procedure; and routing packets, associated with said session, over the second connection based on the acquired gateway address.

In accordance with a second exemplary embodiment of the invention, a method  
15 of keeping a session active and connected while changing data communications networks comprises the steps of: receiving packets, associated with a session, from a first data communications network; moving to a second data communications network; selecting a preferred gateway in the second data communications network; initiating an unsolicited connection procedure in the second network for a second connection, wherein said  
20 connection request includes an address of a gateway associated with said first network; forwarding packets, associated with said session, to said preferred gateway through said connection procedure; and receiving said forwarded packets from said preferred gateway over said second connection.

In accordance with a third exemplary embodiment of the invention, a method of  
25 keeping a session active and connected while changing data communications networks comprises the steps of: receiving packets, associated with a session, from a first data communications network; sending routing information from a gateway in said first network to one or more gateways in neighboring data communications networks using an unsolicited connection procedure; establishing a connection between user equipment and

a second gateway, said second gateway being one of said one or more gateways in the neighboring data communications networks that is associated with a target cell; forwarding packets, associated with said session, from said gateway in said first data communications network to said second gateway; and receiving, in the user equipment, 5 said forwarded packets from said second gateway.

In accordance with a fourth exemplary embodiment of the invention, a method of keeping a session active and connected while changing data communications networks comprises the steps of: receiving packets, associated with a session, from a first data communications network; sending a request for access, from user equipment receiving 10 said packets, to a second data communications network; initiating an unsolicited connection procedure to a gateway in said second data communications network; returning an address of the gateway in the second data communications network to said user equipment; sending said address to a gateway in said first data communications network; forwarding packets, associated with said session, from said gateway in the first 15 data communications network to said gateway in the second data communications network using said address; and receiving, at said user equipment, the forwarded packets from said gateway in said second data communications network.

#### BRIEF DESCRIPTION OF THE DRAWINGS

20 The objects and advantages of the invention will be understood by reading the following detailed description in conjunction with the example drawings in which:

FIGs. 1-3 illustrate flow diagrams of method steps in accordance with exemplary embodiments of the invention;

25 FIG. 4 is a flow diagram of a detach procedure in accordance with another exemplary embodiment of the invention;

FIGs. 5-7 illustrate system diagrams showing messaging in accordance with exemplary embodiments of the invention;

FIGs. 8-11 illustrate flow diagrams of method steps in accordance with a further exemplary embodiment of the invention;

FIG. 12 illustrates a system diagram showing messaging in accordance with an exemplary embodiment of the invention; and

FIG. 13 illustrates a flow diagram of an exemplary terminal assisted handover process.

5

### DETAILED DESCRIPTION

Seamless data communication can be achieved in exemplary embodiments of the invention through modification of the communication protocol to enable the implementation of inter-packet network roaming. In exemplary embodiments, inter-

network roaming is provided at the gateway level (example of gateways: H.323 GW,

- 10 GPRS gateway, MobileIP Foreign Agent, etc.), where the gateway for the network from which a user has roamed, and the gateway for the network that the user has roamed into, are inter-operable either directly or through another gateway or proxy. To achieve inter-packet network roaming, exemplary embodiments allow a request for handover resources, using a new method named as an unsolicited connection procedure, in the network into
- 15 which the user is roaming (the target network) to be initiated either by the current serving network, the target network, or by user equipment (e.g., user terminal).

The request for hand-over resources in the target network may thus be achieved in exemplary embodiments using three different techniques: 1) serving network initiated handover (SNH), where the gateway in the serving network broadcasts to possible

- 20 candidate handover gateways using measurement reports provided by the user equipment; 2) target network initiated handover (TNH), where the user equipment requests the target network to notify the current serving network that the user has moved from the network and further requests that packets be forwarded to a new gateway address; and 3) terminal assisted handoff (TAH), where the user equipment performs handoff measurements, 25 requests resources from the target network, and then forwards the information uplink to the current serving gateway which then sets up a communication path with the target gateway as supplied by the user equipment.

An exemplary GPRS based method of re-routing an established session to user equipment, when the user roams from a routing area administered by a first network to a

040010-440 101295

routing area administered by a second network, is illustrated in Figures 1-4 and 13, with associated system messaging shown in Figures 5-7. Beginning with Figure 1, the user equipment first acquires **100**, through possibly modified mobility management procedures, the address of the current serving GGSN (GGSN<sub>1</sub>) that may subsequently be included in the optional information element contained in the PDP context accept message. This address may be acquired through messages broadcast (**500**; Figure 5) on downlink control channels before the user equipment first initiates a session in the first network.

At step **110**, measurements of necessary signal quality in the current and neighboring cells are performed, using conventional techniques, as the user equipment roams throughout the current network. If serving network initiated handover is used, then step **110** of Fig. 1 proceeds to step **305** of Fig. 3 (See “Serving Network Initiated Handover” section below). If either target network initiated handover, or terminal assisted handover are used then the process proceeds to step **115** of Fig. 1. An evaluation **115** of the signal quality measurements is further performed in accordance with conventional techniques to select a target cell for hand-off in the event the user equipment roams from the edge of the current cell into a neighbor cell. The SGSN<sub>1</sub> (**530**; Fig. 5) then can determine **120**, using a local database containing roaming information, that the candidate target cell resides in a network that is external to the current serving network. If the target cell resides within the current serving network, conventional routing procedures are initiated **125**. If, however, the target cell does reside in an external network (implying inter-gateway handoff), a re-routing procedure in accordance with the exemplary embodiments is performed.

Two alternative techniques can be used for re-routing the data to the user equipment in the candidate network. In a first technique (TNH), where the target network initiates handover of the data communication, GGSN<sub>1</sub> begins forwarding the buffered packets after being contacted by the GGSN in the external network (GGSN<sub>2</sub>). In a second technique (TAH), where the user equipment initiates handover, GGSN<sub>1</sub> begins forwarding the buffered packets when the user equipment supplies the address of GGSN<sub>2</sub>.

A GPRS system has been used to illustrate the different techniques (TNH, SNH, TAH) for re-routing data. Other systems, however, can easily use these techniques to provide wide area network mobility.

## 5 Target Network Initiated Handover (TNH)

Following the acquisition 100 of the current GGSN by the user equipment (as shown in Fig. 1), an exemplary GPRS based target network initiated handover process can be performed, as illustrated in Fig. 2. In this exemplary process, the user first roams into the target cell before the user equipment initiates 210 a routing area update to the SGSN serving the target cell (SGSN<sub>2</sub>). This routing area update can optionally include the address of GGSN<sub>1</sub> (535; Fig. 5) in the current serving network or other parameters such as the Routing Area ID (specified in ETSI GSM 03.60) and session parameters. SGSN<sub>2</sub> (550; Fig. 5) then initiates 215 an unsolicited PDP context request (520; Fig. 5) towards the preferred GGSN in the target network. This PDP context request will include the GGSN<sub>1</sub> address if this address has been provided by the user equipment. If this address has not been provided by the user equipment, GGSN<sub>2</sub> will fetch 225 (525; Fig. 5) the GGSN<sub>1</sub> address from the home location register (HLR) (540; Fig. 5) after receiving the unsolicited PDP context request from SGSN<sub>2</sub>. GGSN<sub>2</sub> then initiates 230 a tunnel establishment procedure (e.g., IETF, ETSI GSM 9.60) towards GGSN<sub>1</sub>. Buffering of data in the current serving network can be initiated by SGSN<sub>1</sub> (530; Fig. 5) after the unsolicited connection procedure has been completed. To complete the re-routing process, GGSN<sub>1</sub> updates the routing information 235 for the PDP context address and starts forwarding packets (560; Fig. 5) to GGSN<sub>2</sub>. GGSN<sub>1</sub> additionally informs 240 SGSN<sub>1</sub> to remove PDP context data associated with the mobile terminal (555; Fig. 5).

25

## Serving Network Initiated Handover (SNH)

In an exemplary GPRS based serving network initiated handover process shown in Fig. 3, the handover candidate cells are first determined 305 based on the signal quality measurement reports. Using a lookup database for the cells, the network identities (625;

Fig. 6) to which networks the candidate cells belong (if they are outside the serving network) are then retrieved **310**. A request is then sent to the current serving GGSN to initiate **320** an unsolicited PDP request to the corresponding candidate networks. The GGSN would first look up **315** the address for the point of attachment (POA) of these networks and then forward the unsolicited requests to the retrieved addresses. The transfer procedure begins before a target cell has been chosen by the equipment, therefore the transfer procedure/connection request will be sent to all GGSNs associated with any of the candidate cells. If any of the candidate cells could reside in the original network as well as in neighboring networks, a conventional intra-network procedure will be initiated at the same time as this new procedure. It may be possible that more than one point of attachment address is returned for one candidate network, in which case, the GGSN may choose to forward the request to all of them or to select only one address from the list.

Fig. 6 shows the scenario where two candidate networks (Candidate 2 **635** and Candidate 3 **630**) were selected and one point of attachment is returned per candidate network. The serving GGSN initiates an unsolicited PDP context request towards GGSN<sub>2</sub> **605** and GGSN<sub>3</sub> **610** which includes information such as the current RA (routing area) and the candidate RAs (RA<sub>2</sub> **615** and RA<sub>3</sub> **620** respectively). GGSN<sub>2</sub> **605** and GGSN<sub>3</sub> **610** would look up the corresponding SGSNs using the received candidate routing area information. Once the candidate GGSN's (GGSN<sub>2</sub> and GGSN<sub>3</sub>) have looked up their corresponding SGSNs (SGSN<sub>2</sub>, SGSN<sub>3</sub>) associated with the candidate RAs, the unsolicited PDP context request is forwarded down to the SGSNs from the GGSNs in the candidate networks. For clarification, it is noted that the relationship between SGSN and GGSN may not be one to one. Many GGSNs could contact the same SGSN.

At step **325**, SGSN<sub>2</sub> and SGSN<sub>3</sub> determine if a routing area update has been received from the user equipment. If not, SGSN<sub>2</sub> and SGSN<sub>3</sub> will locate **330** the user equipment to request that the equipment respond to the locate with a routing area update. The user equipment decides to respond to the locate in RA<sub>2</sub> and responds with a routing area update message back to SGSN<sub>2</sub>. Meanwhile SGSN<sub>3</sub> is informed that the user equipment is not reachable in RA<sub>3</sub> and informs GGSN<sub>3</sub> about the failure to reach the user.

GGSN<sub>3</sub> responds back to the serving GGSN that candidate Net\_Id3 is not able to reach the user. The serving GGSN waits for the other responses to come back from the other candidate network. When SGSN<sub>2</sub> receives the routing area update message from the user equipment as a response to the locate, it will send **335** an unsolicited PDP context message back to GGSN<sub>2</sub>. GGSN<sub>2</sub> then responds **340** to the request from GGSN<sub>1</sub> by establishing a path with GGSN<sub>1</sub>. Only the first successful response from a candidate GGSN would be accepted, the rest would be discarded. After the path between GGSN<sub>1</sub> and GGSN<sub>2</sub> is established, GGSN<sub>1</sub> begins **345** forwarding Packet Data Units (PDU's) to GGSN<sub>2</sub>. To complete the re-routing process, GGSN<sub>1</sub> informs **350** SGSN<sub>1</sub> to remove PDP context data associated with the mobile terminal.

#### Terminal Assisted Handover (TAH)

In an exemplary GPRS based terminal assisted handover process shown in Fig. 13, the user equipment (e.g., terminal) itself initiates the hand-off to the target network. Once the user equipment selects a target cell (**115**; Fig.1), the user equipment requests (**1300**; Fig. 13) access to the target network using, for example, an access handoff message. This request would include the type of service required, the quality of service, the session information, and the address of the GGSN of the network currently serving the user equipment (address of GGSN<sub>1</sub>). In response to the access request from the user equipment, an unsolicited context request would be initiated **1305** from SGSN<sub>2</sub> in the target routing area towards GGSN<sub>2</sub> in the target network. The target network would then grant **1310** admission to the user equipment and secure resources to provide a connection with the equipment. The target network would further provide the address of the serving GGSN (GGSN<sub>2</sub>) in the target network to the user equipment. The user equipment subsequently notifies **1315** the current serving SGSN<sub>1</sub>/GGSN<sub>1</sub> of the equipment's readiness for handoff and supplies the address of GGSN<sub>2</sub>. SGSN<sub>1</sub> requests GGSN<sub>1</sub> to buffer the data. The user equipment may also supply a new PDP address if provided by the target network.

In response to the notification from the user equipment, the serving GGSN<sub>1</sub> then starts forwarding **1320** data packets intended for the user equipment to the GGSN address (GGSN<sub>2</sub>) provided by the user equipment. When the user equipment begins receiving data **1330** from the new channel established with the target network, the user equipment  
5 releases **1335** the old channel with the previous network.

Following completion of any of the three of the inter-GGSN packet re-routing techniques described above, an optional procedure for PDP context deactivation may be performed as shown in Figure 4. The method of Figure 4 may be initiated following the termination of Packet Data Unit (PDU) transfer from GGSN<sub>1</sub> to GGSN<sub>2</sub>. In this  
10 exemplary method, SGSN<sub>2</sub> first initiates **400** a Detach procedure (**700**; Fig. 7) towards the user equipment, requesting that the terminal initiate Attach and PDP context activation procedures. The SGSN<sub>2</sub> then initiates **405** a Delete PDP context (**705**; Fig. 7) with the serving GGSN<sub>2</sub>. In turn, the GGSN<sub>2</sub> initiates **410** a procedure to delete path establishment with GGSN<sub>1</sub>.

15 Subsequent to the delete path procedure by GGSN<sub>2</sub>, the user equipment begins **415** an Attach procedure (**710**; Fig. 7) towards SGSN<sub>2</sub>, using conventional messaging such as, for example, that described in the GSM Standard 03.60. In response to the Attach request from the user equipment, SGSN<sub>2</sub> initiates **420** a location update request (**715**; Fig. 7) towards the HLR. The HLR then initiates **425** a location cancellation  
20 procedure (**720**; Fig. 7) towards SGSN<sub>1</sub>. SGSN<sub>2</sub> then sends **430** an Attach accept message (**725**; Fig. 7) to the user equipment, which in turn responds by initiating **435** an Activate PDP context request (**730**; Fig. 7) towards SGSN<sub>2</sub>. Subsequently, SGSN<sub>2</sub> initiates **440** a create PDP context request (**735**; Fig. 7) with GGSN<sub>2</sub>. The user equipment or SGSN<sub>2</sub> may request a PDP context activation with GGSN<sub>1</sub> in certain circumstances  
25 such that GGSN<sub>2</sub> creates a hierarchical tunnel between GGSN<sub>2</sub> and GGSN<sub>1</sub>. For example, the hierarchical tunnel may be created in the circumstance where a connection request cannot be satisfied by the current serving network.

**Target Network Initiated Handover Using MobileIP**

Another exemplary embodiment of the invention for providing seamless data communication between two packet networks is shown in Figures 8-11, with associated system messaging shown in Figure 12. In this solution to the problem of re-routing

5 packet data when user equipment roams from a routing area administered by a first serving network to a routing area administered by a second serving network, it is assumed that the first and second serving networks communicate using MobileIP protocol. At step  
800, the user equipment first performs an attach procedure and requests PDP context activation (1200; Fig. 12) when registering in the first serving network ("Serving  
10 Network 1"). At step 810, the user equipment acquires (1205; Fig. 12) the care-of address of the local foreign agent (GGSN<sub>1</sub>/FA<sub>1</sub>/AAA<sub>1</sub>) in the first serving network from agent advertising messages that are broadcast by the foreign agent in accordance with conventional techniques. As shown at optional step 805, the user equipment may alternatively acquire the foreign agent care-of address (FA COA) through modified  
15 system messages broadcast over the air interface.

After acquisition of the FA COA, the user equipment initiates 815 a MIP registration request (1210; Fig. 12) to the local foreign agent (GGSN<sub>1</sub>/FA<sub>1</sub>/AAA<sub>1</sub>) in serving network 1. The MIP request would include a Network Access Identifier (NAI) that identifies the user equipment's home environment. The MIP registration request,  
20 however, may be included as an optional information element within the original PDP context Activation message from the user equipment so as to minimize the signaling sequence. If, though, the user equipment is not MIP capable, then the GGSN in the current serving network can assume the role of surrogate agent and initiate a MIP registration request after PDP context activation on behalf of the user equipment.

25 The FA<sub>1</sub>/AAA<sub>1</sub> component of GGSN<sub>1</sub> then determines 820 that the registration request must be forwarded to the home environment identified by the NAI. FA<sub>1</sub>/AAA<sub>1</sub> sends 825 the registration request (e.g., a DIAMETER message) (1215; Fig. 12) to the AAA server (AAA<sub>home</sub>) in the home environment. If the registration request requests the assignment of a home agent, AAA<sub>home</sub> will attempt to assign a home agent (HA3) from

the serving network if one is available and is capable of handling the load **900**. If one is not available,  $\text{AAA}_{\text{home}}$  will assign **905** a home agent in the home environment HA1.  $\text{AAA}_{\text{home}}$  then forwards **910** the MIP registration request (**1220**; Fig. 12) in an AAA message to HA3.

- 5       Upon receipt of the forwarded MIP registration request, HA3 validates **915** and stores binding information for the mobile terminal and then updates the routing table. HA3 then formulates a registration reply (**1225**; Fig. 12) and returns **920** it to the  $\text{AAA}_{\text{home}}$  server in the home environment. The  $\text{AAA}_{\text{home}}$  server returns **925** a response **1230** to the registration reply and the registration reply message is forwarded to the user equipment.
- 10      Subsequent to the above-described registration procedure, the user may roam to a new routing area serviced by a new SGSN ( $\text{SGSN}_2$ ) in a network administered by a different service provider. The user equipment then performs **1000** a routing area update procedure (**1235**; Fig. 12), wherein the routing area parameters may include additional information such as the old foreign agent address and the current home agent address.
- 15      The user equipment would then acquire **1005** the new FA COA from an unsolicited PDP context activation response (**1240**; Fig. 12) from the new foreign agent in the new GGSN. Optionally, the user equipment could acquire **1010** the FA COA in system broadcast messages.

- 20      The new SGSN ( $\text{SGSN}_2$ ) then determines if MIP connectivity is required. If MIP connectivity is required, and is supported by  $\text{GGSN}_2$ ,  $\text{SGSN}_2$  initiates **1015** an unsolicited PDP context activation which may contain information regarding the old foreign agent, the current home agent, and the NAI. The activation request (**1245**; Fig. 12) would be sent to a pre-defined foreign agent such as  $\text{GGSN}_2/\text{FA}_2/\text{AAA}_2$ . If roaming agreements between the provider of serving network 1 and the provider of serving network 2 permit, the new foreign agent  $\text{FA}_2$  communicates (**1250**; Fig. 12) with the old foreign agent  $\text{FA}_1$  to inform  $\text{FA}_1$  that the user equipment is currently located within  $\text{FA}_2$ 's service area.  $\text{FA}_2$  then formulates **1025** a MIP registration request using the information received in the unsolicited PDP context activation and forwards the request (**1255**; Fig. 12) to  $\text{AAA}_{\text{home}}$ .

This MIP registration request may indicate that a new home agent be allocated. FA<sub>2</sub> will now be ready to receive forwarded packets.

After receipt of the MIP registration request from FA<sub>2</sub>, the home environment AAA server forwards **1030** the request (**1260**; Fig. 12) to the home agent HA4 in serving network 2 to create binding information for the user equipment and to update the routing table. When a successful MIP registration reply is received, AAA<sub>home</sub> notifies **1100** HA3 to remove the binding information if not currently in use. AAA<sub>home</sub> then forwards **1105** the MIP reply answer (**1265**; Fig. 12) to FA<sub>2</sub> in an AAA message.

The above described exemplary embodiments describe inter-packet domain roaming in either GPRS or MobileIP networks. However, one skilled in the art will recognize that these exemplary techniques can be applied to any IP based communication protocol. For example, the exemplary embodiments describing inter-packet domain roaming using MobileIP protocol can be applied to other multi-media networks such as H.323 or SIP. The protocols currently defined in H.323 and SIP would need to be changed to include this functionality in accordance with the exemplary embodiments.

The above described exemplary embodiment describes how session mobility between two packet networks in a wireless system is achieved. A session, as is known today in the datacom world, is used to run one or more applications (e.g., voice over IP, web browsing). A session is transparent to the network layer, therefore when a user moves from one network to another, the session is unaware that the lower layers are reconfigured due to a new re-established connection. Session mobility involves a user having an active session on his/her user equipment and moves together with the equipment towards a new area served by a new network. The two networks cooperate in order to allow the user to continue working with his/her ongoing session.

Session mobility also involves a user having an open and active session running on his/her user equipment and moving without taking the equipment to another network (e.g., from work to home). The user, in the new network decides to connect to and continue with the same session through a different terminal. The exemplary embodiments described above could be used to allow for both scenarios. The second

scenario, however, allows for total network transparency and permits the user to connect to an ongoing session via another terminal located in a different network that may be wireless or fixed. For example, if a user is engaged in a session at a first terminal connected to a first network, the user may connect to a second terminal in a second network and the session may be re-routed, applying the exemplary embodiments described above, to the new terminal without loss of the ongoing session. Re-routing of the session may be achieved using a new user interface at the first terminal which prompts the user to enter the terminal to which the user is transferring. The input terminal information is then converted to a location (e.g., network entity address serving the terminal) of the new system by querying a local database (e.g., DNS).

Although a number of embodiments are described herein for purposes of illustration, these embodiments are not meant to be limiting. Those skilled in the art will recognize modifications that can be made in the illustrated embodiments. Such modifications are meant to be covered by the spirit and scope of the appended claims.

**What is Claimed is:**

1. A method of keeping a session active and connected while changing data communications networks, comprising the steps of:

receiving packets, associated with a session, over a first connection in a first data communications network;

requesting a second connection with a second data communications network while moving towards the second network;

acquiring an address of a gateway associated with the second data communications network, wherein said steps of requesting and/or acquiring use an unsolicited connection procedure; and

routing packets, associated with said session, over the second connection based on the acquired gateway address.

2. The method of claim 1, wherein an entity in the second data communications network initiates the request for the second connection.

3. The method of claim 1, wherein a gateway in the first data communications network initiates the request for the second connection.

4. The method of claim 1, wherein user equipment initiates the request for the second connection.

5. A method of keeping a session active and connected while changing data communications networks comprising the steps of:

receiving packets, associated with a session, from a first data communications network;

moving to a second data communications network;

selecting a preferred gateway in the second data communications network;

initiating an unsolicited connection procedure in the second network for a second connection, wherein said connection request includes an address of a gateway associated with said first network;

forwarding packets, associated with said session, to said preferred gateway through said connection procedure; and

receiving said forwarded packets from said preferred gateway over said second connection.

6. A method of keeping a session active and connected while changing data communications networks comprising the steps of:

receiving packets, associated with a session, from a first data communications network;

sending routing information from a gateway in said first network to one or more gateways in neighboring data communications networks using an unsolicited connection procedure;

establishing a connection between user equipment and a second gateway, said second gateway being one of said one or more gateways in the neighboring data communications networks that is associated with a target cell;

forwarding packets, associated with said session, from said gateway in said first data communications network to said second gateway;

and

receiving, in the user equipment, said forwarded packets  
from said second gateway.

7. A method of keeping a session active and connected while changing data communications networks comprising the steps of:

receiving packets, associated with a session, from a first data communications network;

sending a request for access, from user equipment receiving said packets, to a second data communications network;

initiating an unsolicited connection procedure to a gateway in said second data communications network;

returning an address of the gateway in the second data communications network to said user equipment;

sending said address to a gateway in said first data communications network;

forwarding packets, associated with said session, from said gateway in the first data communications network to said gateway in the second data communications network using said address; and

receiving, at said user equipment, the forwarded packets from said gateway in said second data communications network.

040010-440-2227450

### **Abstract**

A system and method of providing mobility between Internet Protocol (IP) based packet networks is disclosed. The disclosed system and method permits user equipment to roam from one IP based packet network to a second IP based packet network, without any interruption in data communications. Wide area network mobility is achieved through the modification of existing protocols to include additional network gateway addressing information.

094625410129

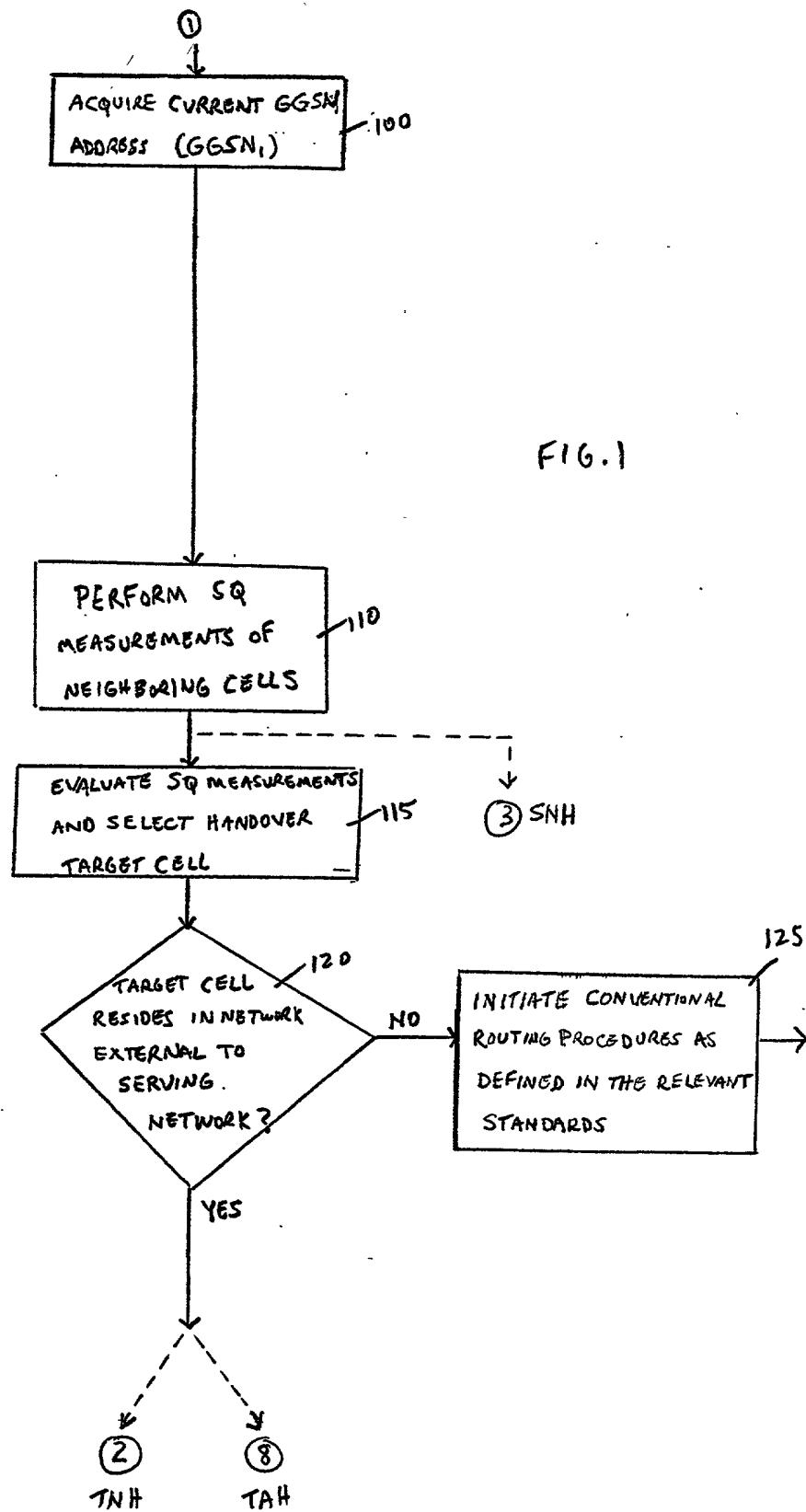
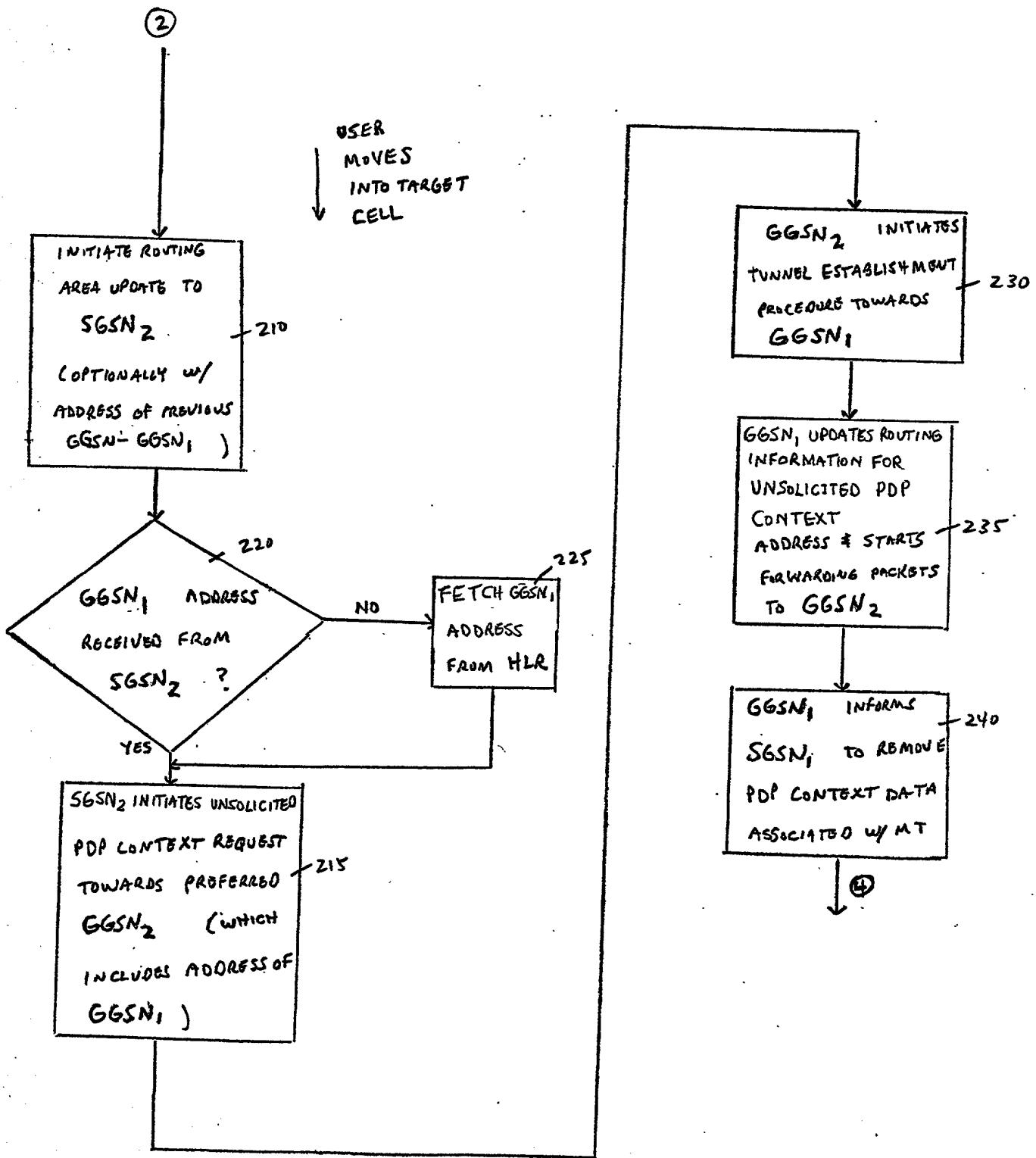
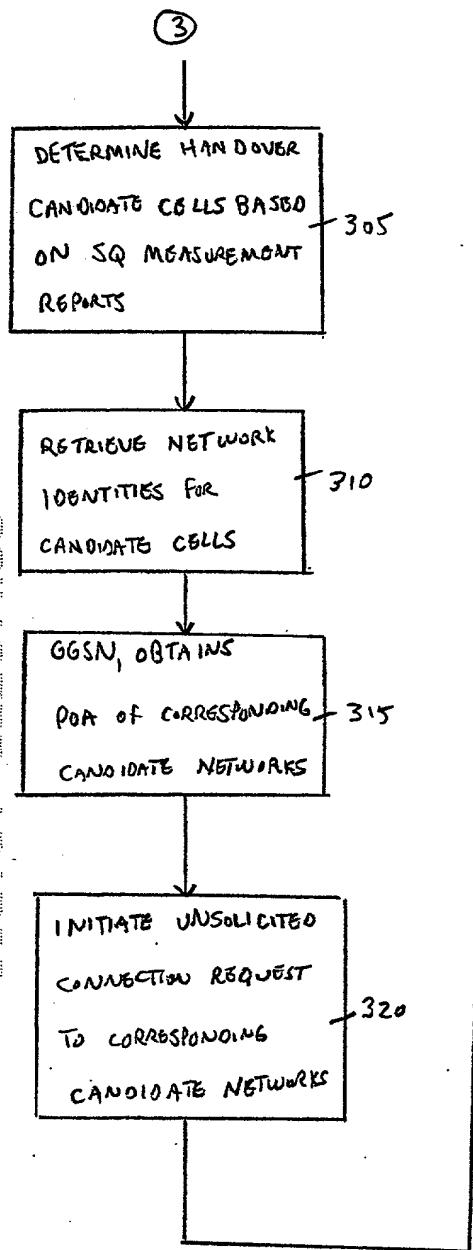


FIG.1

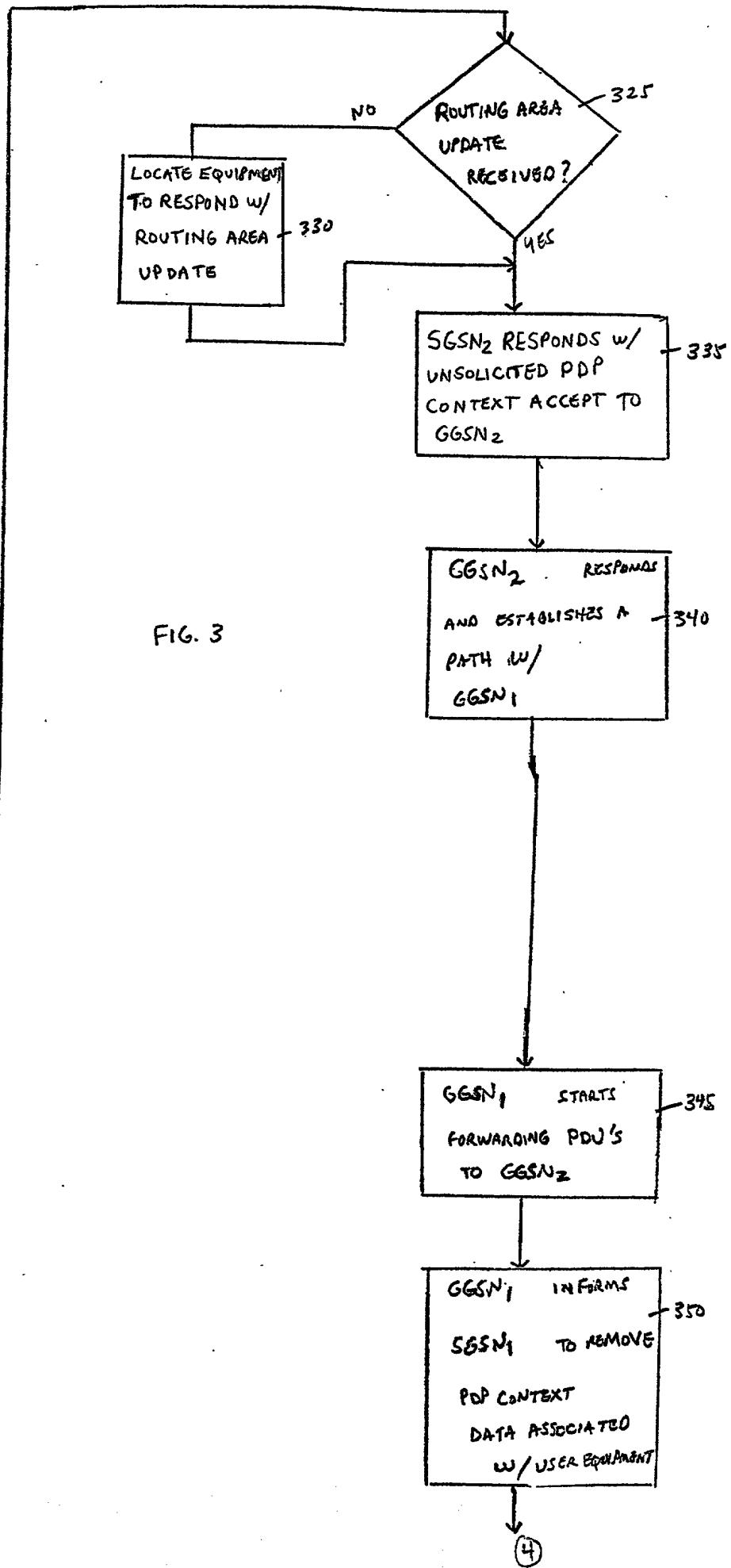
FIG. 2



0945162573101298



USER MOVES  
INTO TARGET  
CELL



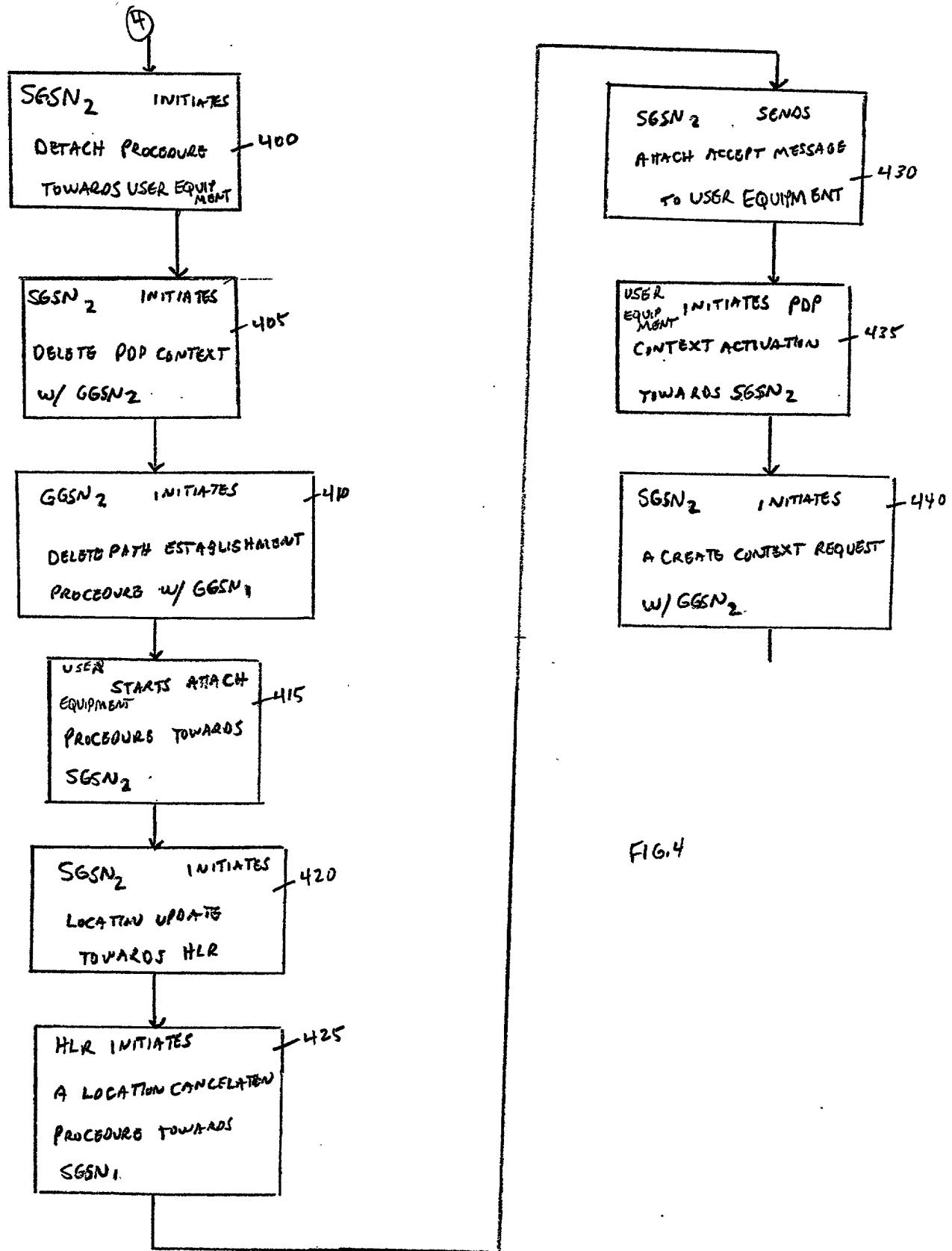
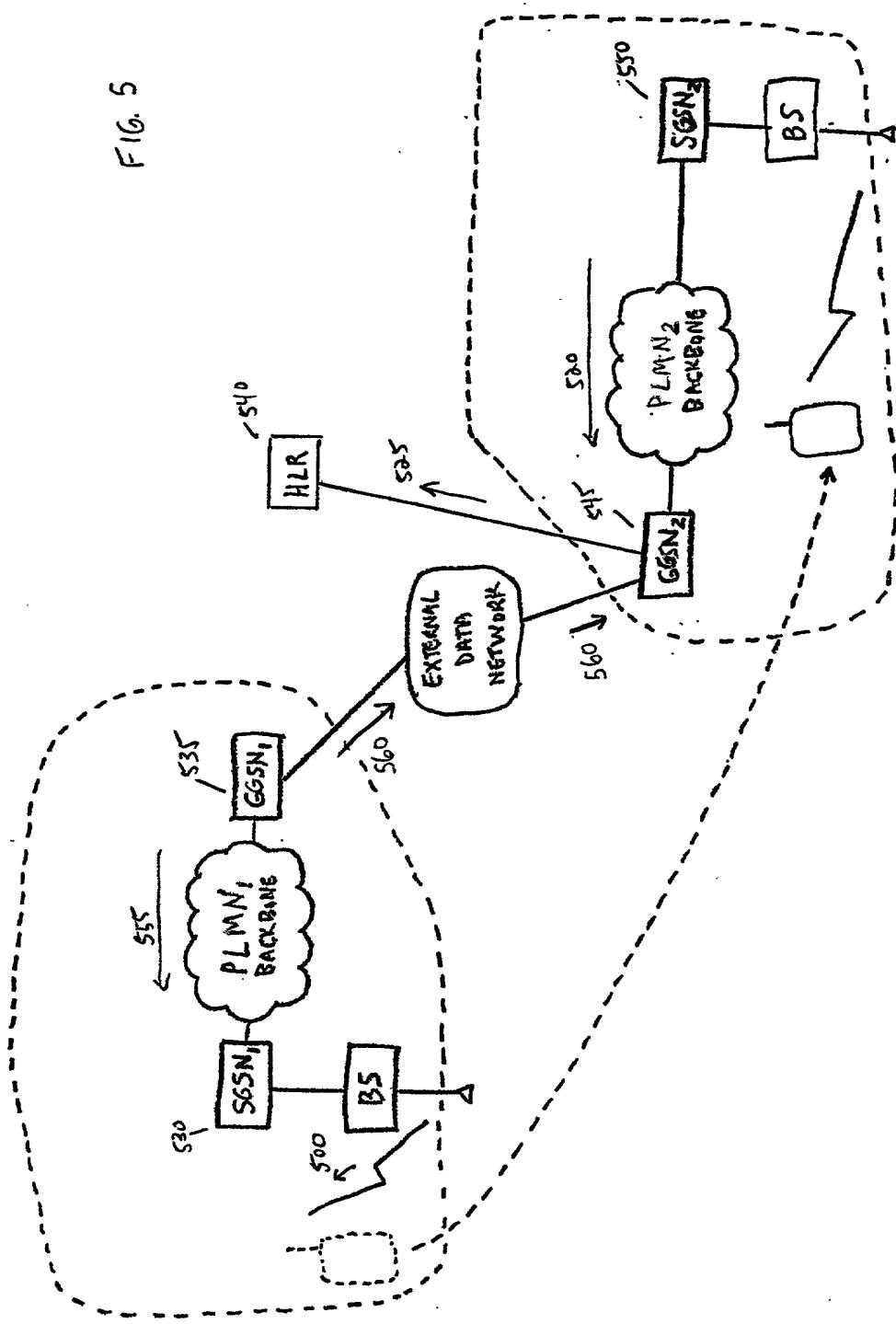


FIG.4

۱۶۵



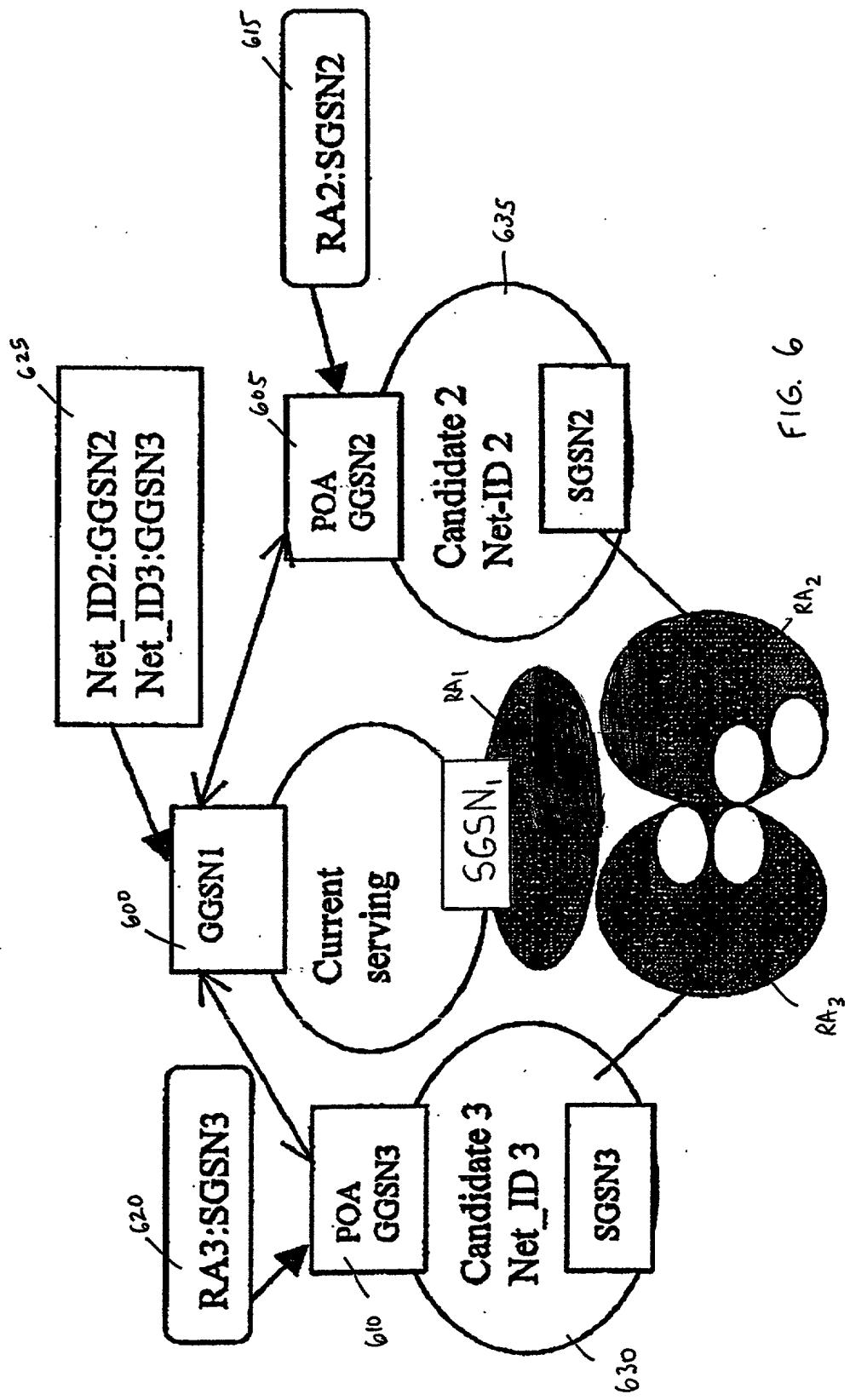
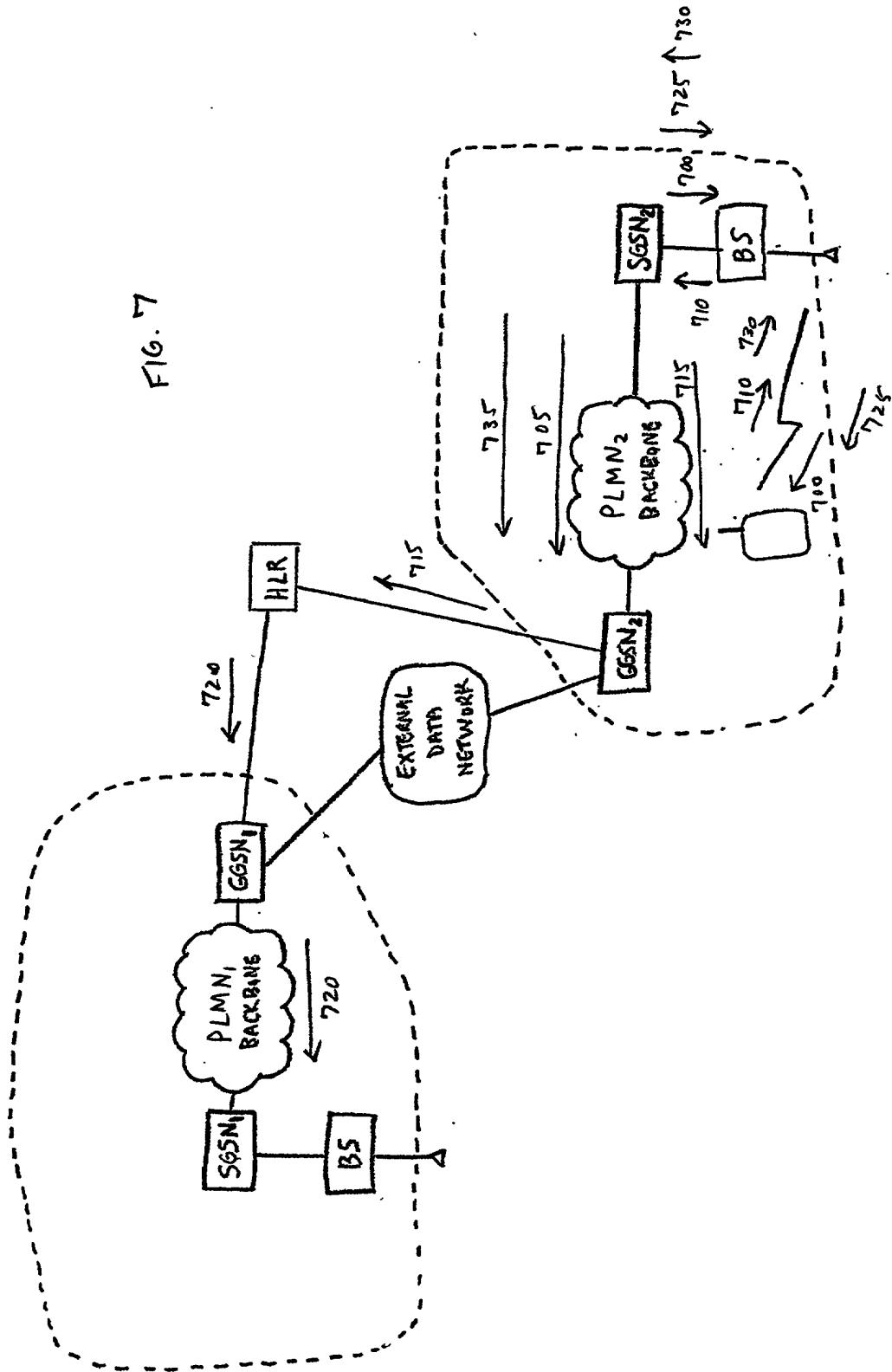


FIG. 6

Fig. 7



0941675416160

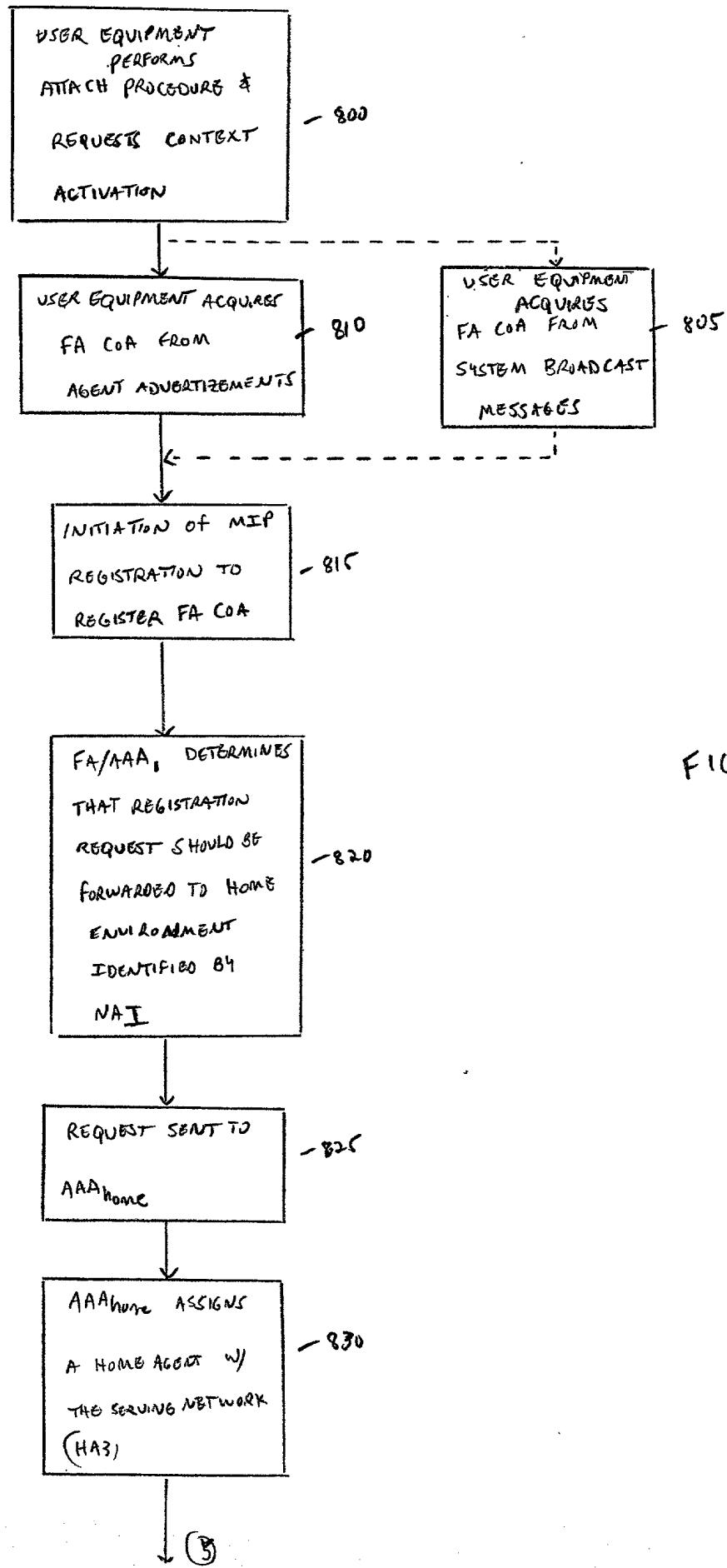


FIG. 8

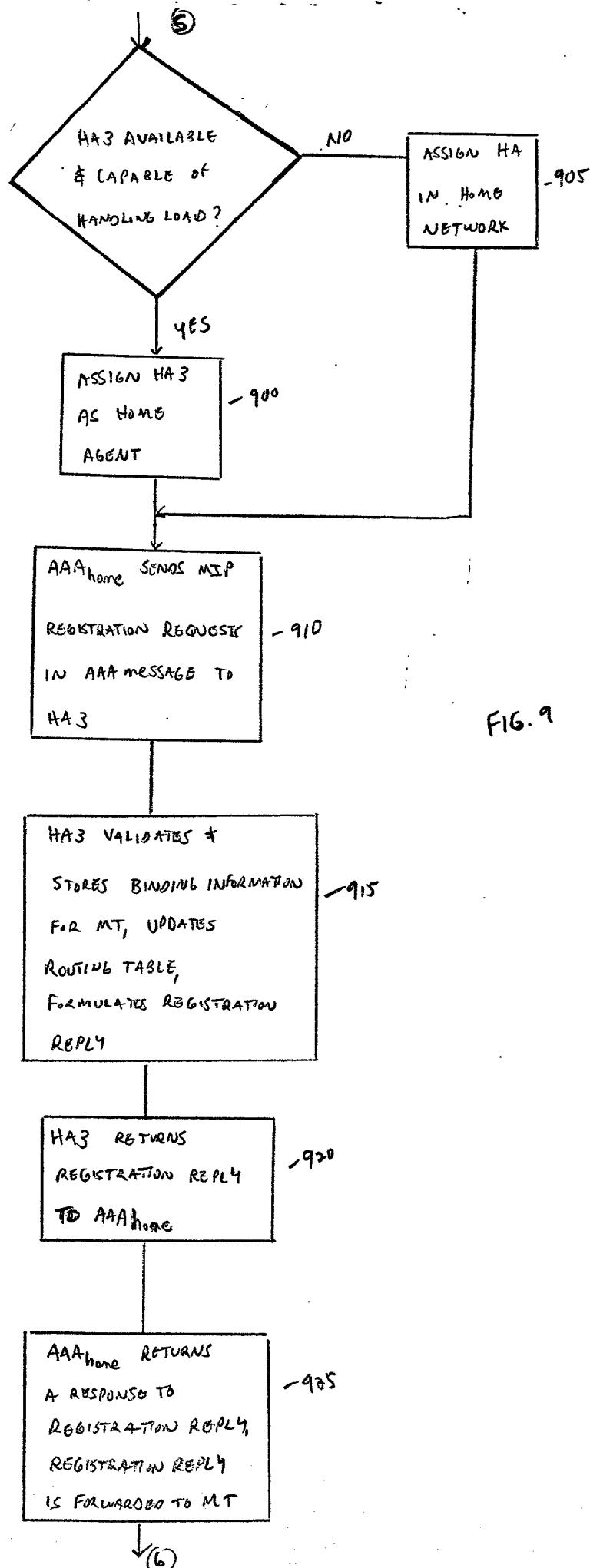


FIG. 9

0943675 = 101295

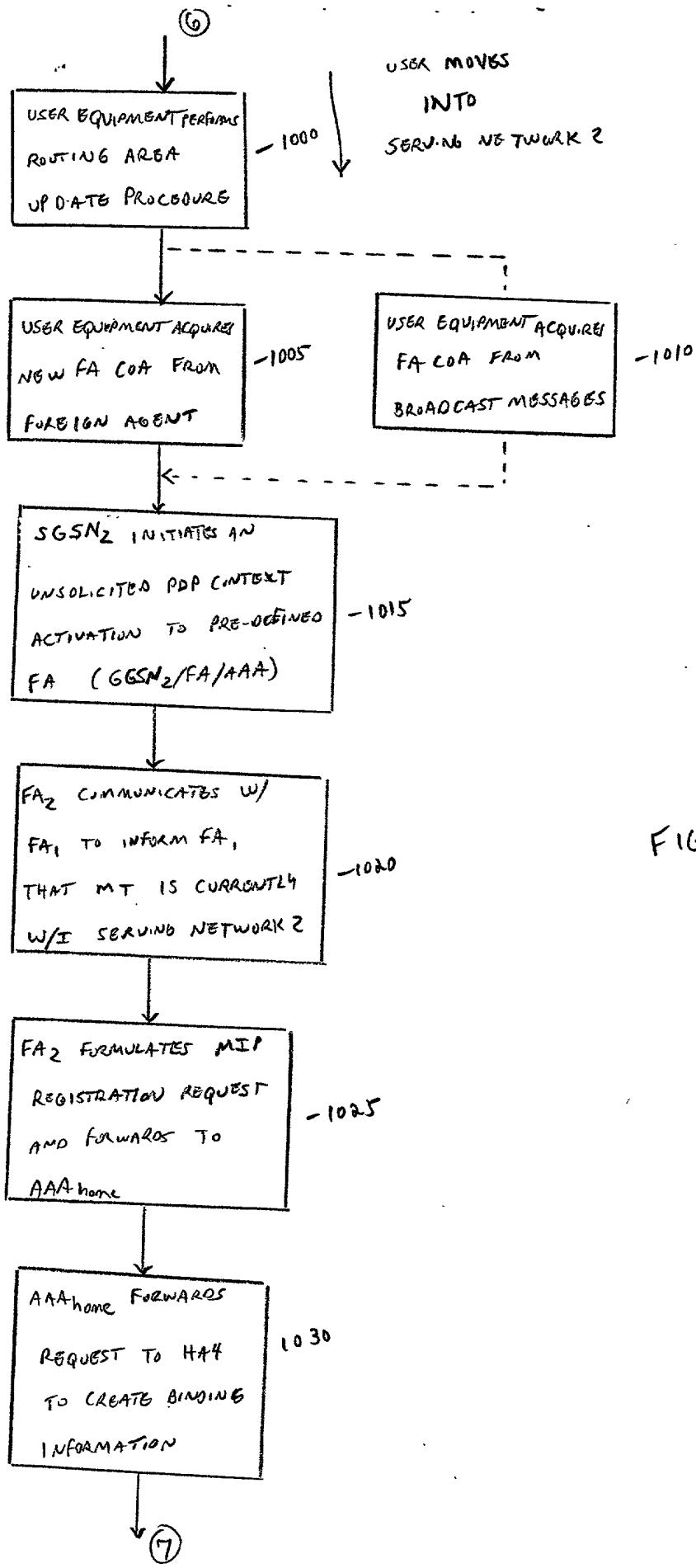
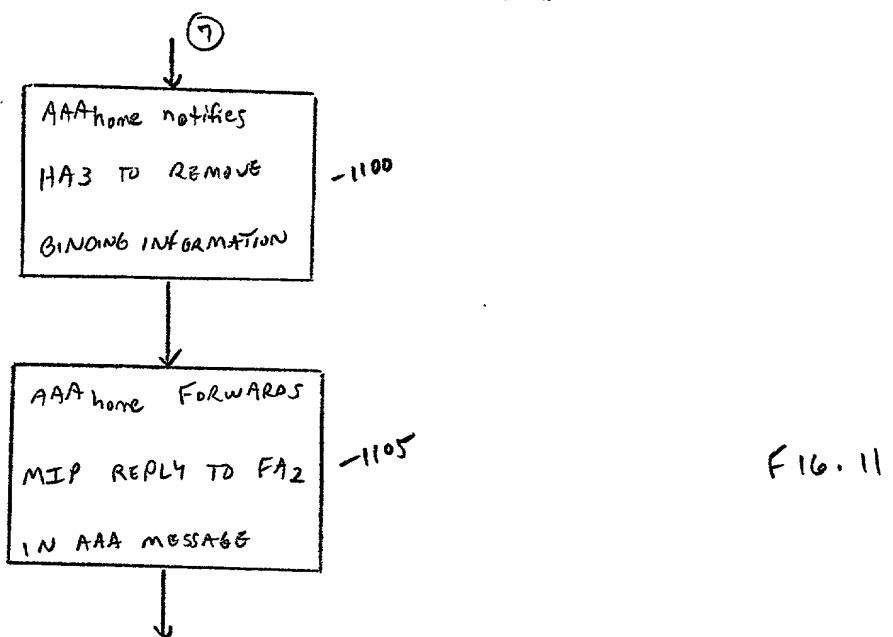


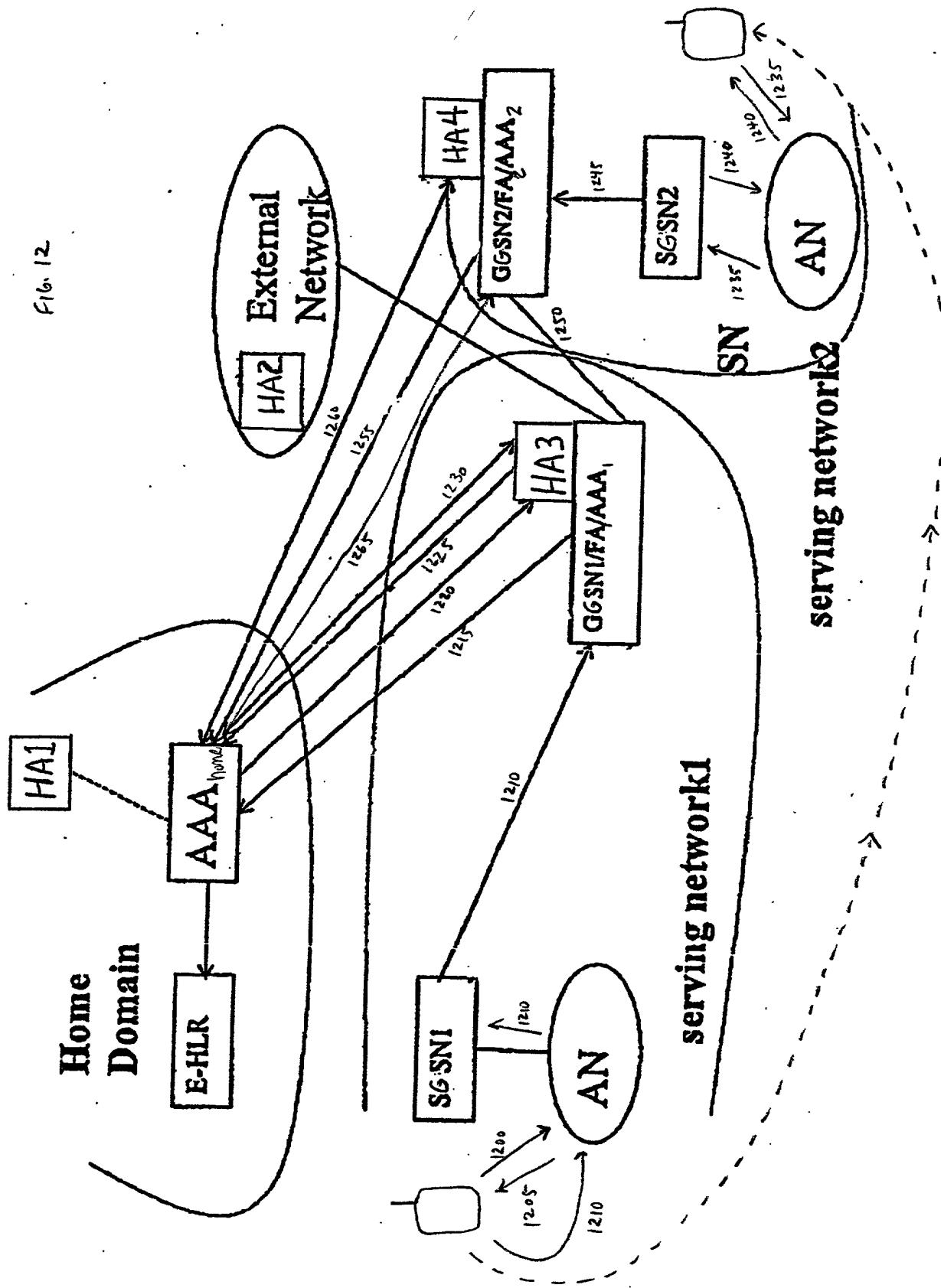
FIG. 10

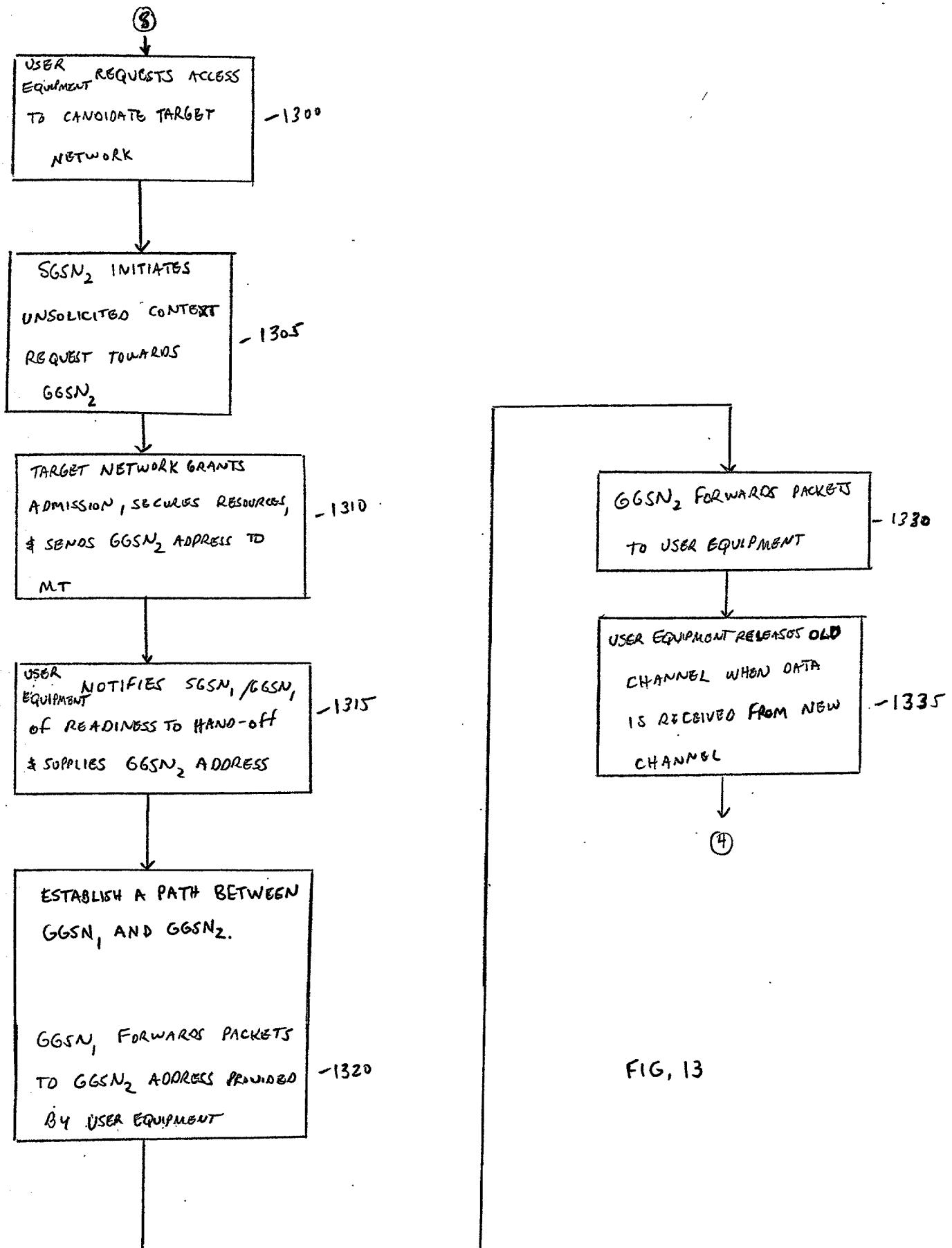


F16.11

© 1992 T U D S S T F T 16 0

Fig. 12





FIG, 13

**COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR UTILITY PATENT APPLICATION**

Attorney's Docket No.  
040010-440

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I BELIEVE I AM THE ORIGINAL, FIRST AND SOLE INVENTOR (if only one name is listed below) OR AN ORIGINAL, FIRST AND JOINT INVENTOR (if more than one name is listed below) OF THE SUBJECT MATTER WHICH IS CLAIMED AND FOR WHICH A PATENT IS SOUGHT ON THE INVENTION ENTITLED:

**WIDE AREA NETWORK MOBILITY FOR IP BASED NETWORKS**

the specification of which

(check one)

is attached hereto;

was filed on \_\_\_\_\_ as

Application No. \_\_\_\_\_

and was amended on \_\_\_\_\_ ;

(if applicable)

I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS, AS AMENDED BY ANY AMENDMENT REFERRED TO ABOVE;

I ACKNOWLEDGE THE DUTY TO DISCLOSE TO THE OFFICE ALL INFORMATION KNOWN TO ME TO BE MATERIAL TO PATENTABILITY AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, Sec. 1.56 (as amended effective March 16, 1992);

I do not know and do not believe the said invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to said application; that said invention was not in public use or on sale in the United States of America more than one year prior to said application; that said invention has not been patented or made the subject of an inventor's certificate issued before the date of said application in any country foreign to the United States of America on any application filed by me or my legal representatives or assigns more than twelve months prior to said application;

I hereby claim foreign priority benefits under Title 35, United States Code Sec. 119 and/or Sec. 365 of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application(s) on which priority is claimed:

COMBINED DECLARATION AND POWER OF ATTORNEY			Attorney's Docket No. 040010-440
COUNTRY/INTERNATIONAL	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
			YES_ NO_
			YES_ NO_

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

William L. Mathis	17,337	R. Danny Huntington	27,903	Gerald F. Swiss	30,113
Robert S. Swecker	19,885	Eric H. Weisblatt	30,505	Michael J. Ure	33,089
Platon N. Mandros	22,124	James W. Peterson	26,057	Charles F. Wieland III	33,096
Benton S. Duffett, Jr.	22,030	Teresa Stanek Rea	30,427	Bruce T. Wieder	33,815
Norman H. Stepno	22,716	Robert E. Krebs	25,885	Todd R. Walters	34,040
Ronald L. Grudziecki	24,970	William C. Rowland	30,888	Ronni S. Jillions	31,979
Frederick G. Michaud, Jr.	26,003	T. Gene Diffahunty	25,423	Harold R. Brown III	36,341
Alan E. Kopecki	25,813	Patrick C. Keane	32,858	Allen R. Baum	36,086
Regis E. Slutter	26,999	Bruce J. Boggs, Jr.	32,344	Steven M. du Bois	35,023
Samuel C. Miller III	27,360	William H. Benz	25,952	Brian P. O'Shaughnessy	32,747
Robert G. Mukai	28,531	Peter K. Skiff	31,917		
George A. Hovanec, Jr.	28,223	Richard J. McGrath	29,195		
James A. LaBarre	28,632	Matthew L. Schneider	32,814		
E. Joseph Gess	28,510	Michael G. Savage	32,596		

and: Tony M. Cole - Registration No. 43,417

Address all correspondence to:

Ronald L. Grudziecki  
BURNS, DOANE, SWECKER & MATHIS, L.L.P.  
P.O. Box 1404  
Alexandria, Virginia 22313-1404

Address all telephone calls to: Ronald L. Grudziecki at (703) 836-6620.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR	SIGNATURE	DATE
Lila MADOUR		
RESIDENCE	CITIZENSHIP	
Kista, SWEDEN	Canadian	
POST OFFICE ADDRESS		
c/o Grimson, Kranborgsgränd 14 2tr, SE-164 46 Kista, SWEDEN		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY	SIGNATURE	DATE
Shabnam SULTANA		
RESIDENCE	CITIZENSHIP	
Kista, SWEDEN	Canadian	
POST OFFICE ADDRESS		
c/o Petersson, Bornholmsgatan 2, 3tr, SE-164 46 Kista, SWEDEN		